EPA's Comments on Draft Proposed Site Specific Criteria and Seasonal Use Revision for Chuit River and Three Tributaries

December 12, 2014

The Alaska Department of Environmental Conservation (ADEC) provided draft water quality standards (WQS) revisions and supporting draft decision documents to the U.S. Environmental Protection Agency (EPA) for review on July 30, 2014. The proposed WQS revisions would apply to specified waters in the Chuitna basin and include site-specific criteria (SSC) for four metals and revision of the agricultural use to apply only during specified warmer months. EPA has reviewed these draft documents and provides the following comments for ADEC's consideration.

A. Aquatic Life Site-Specific Criteria

The following comments focus on two general areas: 1) the appropriateness and protectiveness of the proposed Water Effects Ratio (WER)-based SSC. For copper, this analysis includes a comparison to the Biotic Ligand Model (BLM)-derived copper Instantaneous Water Quality Criteria (IWQC) based on available water quality data, and, 2) an assessment of potential water quality issues associated with groundwater resources on site that may be used to supplement surface waters during low flow. For the following reasons, ADEC's draft decision document does not reflect that ADEC has developed a sound scientific rationale for the proposed site-specific criteria for aquatic life protection.

I. Copper

1. Applicability of streamlined WER methodology for copper for the site

Methods: The proposal states that both the *Interim Guidance on Determination and Use of Water-Effects Ratios for Metals* (EPA 1994) and the *Streamlined Water-Effects Ratio Procedures for Discharges of Copper* (EPA 2001) were used for this project. The use of the streamlined WER guidance appears inappropriate in this case because application is intended for copper point source discharges under well characterized stable flow conditions. This project does not have any of those elements. Further, the applicability of the various types of WERs (Type 1 and 2), given that there is currently no discharge-related variability and no effluent, is an important consideration regarding the appropriateness of the use of WER overall. EPA recognizes that it has commented that the denominator in the WER calculation should be the greater of the determined LC50 in laboratory water or the documented species mean acute value (Appendix A, section G.3.c of the Streamlined Approach). That step is independent of the point source discharge and receiving stream design flow conditions necessary to satisfy the applicability of the Streamlined Approach.

2. Representativeness of sampling for calculation of the proposed WER-based SSC for copper for the Chuitna basin

The WER proposal selected one sampling location (Station 141 located on Middle/2003 Creek) for WER testing as a surrogate to represent conditions across the entire site. Also, sampling was conducted just 3 times over a period of only 2 months. Such limited sampling gives EPA reasonable cause to be concerned about whether Station 141 is a representative surrogate for the water chemistry in the watershed where mining activities will occur. Specifically, ADEC has not supplied adequate evidence that Station 141 reflects the full temporal and spatial variability of the water chemistry in the watershed.

Copper bioavailability, and thus copper toxicity, is mainly influenced by 3 parameters – Dissolved Organic Carbon (DOC), pH, and hardness. To further expand the limited set of conditions under which the proposed WER was conducted, EPA used the available Riverside Technologies Inc. 2009 water chemistry report (Appendix B16: Historical Surface Water Quality) and analyzed a subset of data from the most recent collection period, 2006-2008, to better characterize the site spatially and temporally. The report shows a number of Total Organic Carbon (TOC) samples that were lower (<4-6 mg/L) than those at Station 141 (TOC = 4.5 - 7.7 mg/L) (either due to spatial or temporal variation) across the potentially impacted site in a number of tributaries (Chuit River, Lone Creek, Middle Creek). This indicates that low TOC may be spatially and temporally prevalent.

Since DOC concentrations influence copper toxicity and are needed to complete BLM calculations for comparison with the WER-based results, EPA conducted a series of analyses using available DOC and TOC data from the 3 Station 141 WER runs (Table A2 of the draft decision document) to estimate the DOC levels in any given TOC sample. This analysis was used to further consider how DOC may vary spatiotemporally across the site, and thus impact BLM estimates for copper across the site area. The ratio of DOC to TOC was 3:4, based on the data accompanying the Station 141 WERs. That is, it appeared that approximately 75% of the TOC was present as DOC. EPA used the estimated 75% DOC:TOC ratio from Station 141 and estimated the DOC at each location that had more than 3 sampling dates between 2006-2008. The analysis shows that estimated DOC would be less than or equal to 3 mg/L (but greater than 2 mg/L) for 28/130 sites (22%) and DOC would be ≤ 2 mg/L for 31/130 sites (24%). Based on this analysis, DOC would be at or below the lowest DOC tested in the WER analysis 46% of the time. Because DOC is a driver in reducing toxicity of copper in site waters, the relatively high DOC from the WER tests would be expected to result in overestimates of the WER and, after application to the base criteria, would result in site-specific criteria that are not protective of aquatic life.

3. Comparison with Copper BLM indicates WER is not protective, particularly for Round 3 (the low flow scenario)

A comparison of the BLM and the WER using the same run-specific water quality (with low ions for BLM being most conservative) shows a 5-fold difference in the acute value and ~ 6.5-fold difference in the chronic value between the BLM-based estimates and the WER-adjusted SSC (where the WER from that scenario is applied to ADEC's existing criteria at a hardness of 25).

One reason for this difference is ADEC's proposed use of 25mg/L hardness, rather than site water hardness (see subsequent comment). Another source of difference between the two approaches can be explained by the comparison of pH utilized. For the BLM, the actual site pH (6.7) is used whereas the pH during the site water toxicity test for the WER for *Daphnia magna* in Round 3 ranged from 7.2-8.0 in test containers (comparing the site water pH from Table A2 of ADEC's draft decision document with the pH during the actual toxicity test in Table 3.8b of Tetra Tech's March 12, 2010 WER report). This is a minimum difference of ½ pH unit between the analyses, which is a substantial difference since pH is a logarithmic function. Because lower pH increases ionization of metals, a toxicity test run at a pH of 6.7 would likely result in a lower LC50, and this in turn would reduce the WER-based criteria, although the magnitude of the change is uncertain.

Comparison of BLM and WER-based Criteria for WER Round 3

	Criteria Calculated Using BLM at Low Flow Site Conditions*	Criteria Calculated Using Low Flow WER of 5.11** and Hardness of 25 mg/L
CMC	3.51 ug/L	18.06 ug/L
CCC	2.18 ug/L	14.00 ug/L

* Low Flow Site Conditions: DOC = 3.1, pH = 6.7, Hardness = 18

** The calculated values for the individual WER rounds for copper in ADEC's draft decision document are consistent with those in Tables 3.10, 3.11, and 3.12 and section 4.2 of the WER determination report (Tetra Tech, March 12, 2010, pages 22, 23, and 30). However, division of the site water LC50's by the site hardness normalized lab water LC50s (or SMAV as applicable) in the last column of those tables yields 8.8, 5.2857, and 4.875, for Rounds 1 thru 3, respectively (before rounding). This discrepancy should be addressed.

II. Aluminum

1. Establishment of the proposed WER-based SSC for aluminum for the entire site based on one location

The trend observed with the WER based on the flow is highly variable and inadequately explained and characterized.

	Flow	**WER**
Round 1	"High" (13.1 cfs)	7.11
Round 2	"Medium" (6.4 cfs)	2.68
Round 3	"Low" (1.7 cfs)	22.0

The three WERS have a wide range (2.68-22.0) and are highly variable. There is inadequate explanation or hypothesis provided why this trend is observed in the toxicity tests. Additional testing for a larger number of sample locations would help clarify and is suggested. The entire site is being characterized by three samples collected from one sample location. This is not adequate in light of the large variability in toxicity observed across the different flow rates. Given the large variability in results observed within samples from one location, it is likely that additional tests across additional locations would reveal larger spatial and temporal variability.

2. Inadequacy of the use of the geometric mean

Given the variability of the WERs determined for station 141 and the concerns with the round 3 WER (discussed below), EPA does not believe that the *Interim Guidance on the Use of Water Effect Ratios for Metals,* (USEPA, 1994) should be used as a basis to conclude that a geometric mean of the three WERs is appropriate as a final WER. Furthermore, the options in the 1994 Interim Guidance for calculating final WERs are dependent upon the stream flow conditions when individual WERS were determined relative to design flow conditions. Design flow conditions for the application of aquatic life criteria have not been established for the site. Use of the *Streamlined Water-Effect Ratio Procedure for Copper* (USEPA, 2001) to support a geometric mean is not appropriate here. The 2001 method is intended to apply to situations where most of the metal is from continuous point source effluents, the metal is expected to attain its highest concentration under low flow conditions, and the site water quality used in testing is unaffected by recent rainfall events. In contrast, Appendix A of the draft decision document speaks to elevated metals concentrations during high stream flow events (p. 34), as does Appendix D specifically for aluminum (p. 60).

The wide variability of the WERs from the three rounds of testing raises concerns that use of a geometric WER may result in a criterion that is not protective. In particular, EPA notes that the measured pH (6.7) and DOC (3.1 mg/l) for the round 3 WER site water sample suggest that aluminum should have been more bioavailable and would have been expected to result in a lower site water LC50 with an associated smaller WER than calculated. Therefore, incorporation of the Round 3 WER in the geometric mean is questionable.

Due to the high degree of uncertainty regarding what would be an appropriately protective WER to cover the site as a whole, the use of a more protective final WER of 2.68 is recommended, or additional testing should be performed. Additional WER tests could provide useful information regarding a protective and appropriate site-specific criterion for this site.

3. Concerns over sensitive species

In the current aluminum database, the four most sensitive species for chronic toxicity are listed:

Rank[a]	Genus Mean Chronic Value (µg/L) (6.5≤ pH <9.0)	Species
4	2,577	Fathead minnow, *Pimephales promelas*
3	2,168	Midge, *Chironomus riparius*
2	1,636	Brook trout, *Salvelinus fontinalis*
1	1,479	Cladoceran, *Ceriodaphnia dubia*

In the 1988 criteria document: *Ambient Water Quality Criteria for Aluminum - 1988* (EPA 1988), the chronic aluminum criteria of 87 μ g/L is based upon two no observed effect concentrations (NOECs) from studies with brook trout (*Salvelinus fontinalis*) and striped bass (*Morone saxatilis*). EPA has concerns about the sensitivity of salmonids to aluminum, potentially both at the site and downstream of the site. The Alaska Department of Fish and Game website notes that "The Chuit River is on the west side of Cook Inlet 40 miles west of Anchorage. It is a popular public sport fishing location for king salmon, silver salmon, and rainbow trout" and "All five species of Pacific salmon, Pacific herring, and smelt are commercially harvested in the Cook Inlet Area." Thus, potential downstream impacts from the site due to aluminum, and other metals, on salmonids and other taxa should be considered.

III. Zinc

Given that two of the three WERs determined for zinc were reported as 0.94 and 1.00 (the third being 1.72) and considering EPA's comments concerning the use of just three samples from one location to characterize the entire site, EPA is concerned that the data may not support an increase in the zinc aquatic life criteria.

IV. Hardness at which criteria are calculated for copper and zinc

Throughout ADEC's draft decision document, both the current criteria and the proposed site-specific criteria for copper and zinc are calculated with a hardness of 25 mg/l (e.g., Tables 1, 3, 5, and the discussion on page 16). However, the hardness values for the three site water samples used in the WER testing were reported as 12, 16, and 18 mg/l; and additional hardness data for tributaries at the site show average values of 20 mg/l or lower, with minimum hardness values of 5 mg/l (Tables A2 and A4, and Figure A7 of ADEC's draft decision document). There are a number of reasons why using a "capped" hardness of 25 mg/l to calculate criteria for this site, including the proposed site-specific criteria for copper and zinc, is not appropriate.

- The memorandum *Modifications to Guidance Site-Specific Criteria* (EPA, December 3, 1997, Special Uses of the WER Procedure, pg. 4) indicates that if a hardness of 25 mg/l is used in a hardness equation when the actual hardness of the site water is less than 25 mg/l, the resulting level of protection will probably be below that intended by EPA's 1985 guidelines for criteria development (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (EPA 822/R-85-100). "The WER Procedure can be used to provide the intended level of protection when hardness is below 25 mg/L if the WERs…are determined as described [in the guidance] and if the FWER is multiplied times the national criterion concentration that corresponds to the average hardness of the downstream site water at design flow. The FWER must not be multiplied times the national criterion concentration for 25 mg/L."

- EPA's National Recommended Water Quality Criteria: 2002 (EPA-822-R-02-047, November 2002) recommends that hardness not be capped at 25 mg/l, or any other lower hardness, to ensure that protection is not less than intended by EPA's 1985 Guidelines for criteria development.

- Alaska's water quality standards specify that that the actual hardness of the surface water should be used when the hardness is less than 25 mg/l as CaCO3 (Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances, as amended through December 12, 2008, endnote 25).

V. Metals mixture test

EPA agrees that the metals mixture test in the 1994 WER guidance is not intended to itself be a method for deriving site-specific criteria. Rather, the metals mixture test is intended as a follow-up to individual WER analysis and associated site-specific criteria calculations for multiple metals to determine if the individual "proposed" site-specific criteria in combination will be protective. "Proposed" in this context refers to the phase in the site-specific criteria evaluation where the state has completed WER analysis for multiple metals and would move forward to proposal and adoption of site-specific criteria if not for confounding data, such as a toxicity test that shows the mix of the individual "proposed" criteria concentrations to be toxic. While EPA recognizes that some might find the description of the metals mixture test in the 1994 WER guidance in need of clarification, the interpretation presented by Sofield and reiterated by ADEC on page 57 of its draft decision document suggests that EPA presented the metals mixture test with no intended purpose.

With this clarification, EPA remains concerned that the metals mixture test is not adequate to conclude that the proposed site-specific criteria in ADEC's draft decision document would be protective. Reasons for this concern include:

- Table 4 of the July 23, 2014 Sofield review presents a summary of water quality data for the "Chuitna site water used in confirmatory testing" (page 35) that calls into question the representativeness of that sample for use in the metal mixture test. Notably, hardness is reported at 38 mg/l, DOC at 4.3 mg/l, and total suspended solids (TSS) at 46 mg/l. Hardness data presented in ADEC's draft decision document indicates that 38 mg/l is at the high end of observations for the basin and well above the typical hardness for waters in the basin of 20 mg/l or less. As discussed elsewhere in these comments, estimated DOC concentrations for waters in the basin are often lower than 4.3 mg/l. The TSS value of 46 mg/l is also on the high end of TSS data presented in ADEC's draft decision document. For example, only one of the six sampling stations in Table A4 has a reported maximum TSS value greater than 46 mg/l (i.e., 58 mg/l), the average TSS for all six stations is less than 6 mg/l, and the minimum TSS values are all approximately 1 mg/l or less. There is a concern that the water quality parameters in the metal mixture test might have reduced the toxicity of the spiked metals to a degree that would not typically occur in water at the site.

- The July 23, 2014 Sofield review (pages 11-12) seems to call into question the statistical analysis that was used to evaluate the results of the metals mixture toxicity test, suggests that consultation with a statistician may be useful, but then continues to draw conclusions based on the assumption that the spiked site water sample did not produce statistically significant toxicity when compare to the site water control. Likewise, there

is no indication in ADEC's draft decision document that there was any follow-up on Sofield's suggestion.

To further evaluate whether 85% survival of D. magna in the metals mixture spiked site water is statistically significant when compared to 100% survival in the site water control, EPA used the "Test for Significant Toxicity" (TST) to analyze the survival data presented for the metal mixture test in Table 3 of the Sofield review (National Pollutant Discharge Elimination System Test of Significant Toxicity Implementation Document," EPA 833-R-10-033, June 2010). Table 3 of the Sofield review presents survival data for each of 4 replicates for the site water control and the metal mixture spiked site water. The results of the TST analysis was that the spiked site water was toxic. EPA recognizes that this result is in part due to the control performance (100 % survival/no variability between replicates) and is borderline with regard to being a toxicity concern. However, when combined with concerns about the water chemistry in the metals mixture test site water sample (e.g., the hardness, DOC and TSS concentrations), and the concentration of dissolved metal in the mixture test relative to the proposed site-specific dissolved criteria, the results of the TST analysis is another reason to be concerned that the proposed site-specific criteria would not be protective of aquatic life uses at the site.

VI. Duration and frequency in the expression of aquatic life criteria

ADEC should include appropriate duration and frequency components when specifying site-specific aquatic life criteria.

VII. Groundwater

1. High conductivity and potential impacts on aquatic life

Three of four strata sampled have elevated conductivity in the groundwater, exceeding the EPA aquatic life benchmark of 300 us/cm (EPA 2011). As a result, addition of these groundwaters to supplement surface waters at low flow (critical conditions) could have an impact on aquatic life, particularly aquatic insects (EPT) that are an important food source for juvenile salmonids.

In the ADEC submission materials, it is indicated that given the groundwater-dominated nature of this system, at low flows it is expected that the surface water quality will reflect higher concentrations of metals and ions present in groundwater (Tetra Tech Inc. Memorandum, April 23, 2010, to Dan Graham, PacRim Coal, LLC.).

2. Groundwater quality and metals

There are also numerous acute and chronic exceedances of Al, Fe, Pb, Ag, and Zn in the groundwater (Appendix, Table 3). Also, the groundwater had low average pH (6.1-7.1, avg = 6.8; n=20), as well as low TOC (not detected to 2 mg/L, with an average of 1, n=17 with 9/17 samples identified as non-detects). Since the groundwater is proposed to be used to supplement surface flow at low flow, groundwater quality could allow for increased bioavailability of metals, particularly for copper.

B. Human Health Site-Specific Criteria for Manganese

EPA agrees with ADEC's general approach of developing site-specific human health criteria for manganese based on EPA's 2000 human health criteria methodology. As ADEC is aware, EPA has been working closely with Oregon, Washington, and Idaho for several years as they update their human health criteria, and there is significant regional tribal interest in this issue. EPA appreciates the clarifying text that ADEC includes about how the inputs considered for the SSC development are specific to Chuitna and should not be interpreted more broadly. However, as reflected in some of our comments below, it is important to recognize that the State's approach in this instance may inform how the State views other similar situations involving tribal consumption. Therefore, we look forward to continuing our discussions with you on these issues. At this time, EPA is providing the following comments regarding the fish intake parameter used to calculate the criteria and the upward adjustment of the final criteria values.

1. Fish intake rate

The fish intake (FI) rate that ADEC used to establish the site-specific HHC is based on the total fish harvest by residents of Tyonek, Alaska in 2005/2006, divided by the population of Tyonek Native Village. A more recent fish consumption study of Cook Inlet tribes (Seldovia, 2013) is cited in the draft decision document as generally supporting the fish intake value. In selecting a fish intake rate, ADEC should consider and describe in its decision document: 1) how ADEC determined that the area is not a subsistence harvest location for shellfish (e.g., were tribes consulted during the site-specific research?); 2) how it considered the tribal and non-tribal populations who consume fish from the Chuitna basin and the appropriateness of deriving a consumption rate with data from all the villages who consume fish from the basin versus one village; and 3) the appropriateness of using a mean instead of the 90^{th} or 95^{th} percentile of a data set to derive a fish consumption rate.

2. Significant figures and rounding

ADEC determined that the calculated WQC for consumption of organism only and for consumption of water + organisms would be 0.283 mg/L and 0.293 mg/L, respectively. The proposed value is 0.300 mg/L for both criteria (page 27 of the decision document): "DEC proposes SSC of 300 µg/L for manganese to protect human health for both consumption of water + aquatic organisms and for consumption of aquatic organisms only." The rationale for increasing the criterion for consumption of water + aquatic organisms is described on page 27 as: "DEC has determined that adoption of the 0.300 mg/L (300 µg/L) was appropriate as 0.293 mg /L (293 µg/L) is not considered statistically different from EPA's lifetime health advisory for manganese at 300 µg/L (USEPA, 2004)." EPA recommends that ADEC provide a justification for adjusting the criterion for consumption of aquatic organisms only from 0.283 to 0.300 mg/L based on appropriate rounding and significant figure procedures.

C. Agricultural Use Change

1) The scope of criteria affected by the seasonal agricultural use change is not clearly presented in the revised WQS. The following text, combined with Tables 1 and 2 of ADEC's draft use decision document, indicates that only the manganese criterion for irrigation would be affected in association with a seasonal use revision for agriculture (ADEC's 7/25/14 draft use decision document, page 1):

> "…DEC proposes to modify the use subclass designated under 18 AAC 70.020(a)(1)(A)(ii) agriculture (including irrigation and stock watering) and the associated manganese criterion for the waters of Bass Creek, Middle Creek, and Lone Creek, in the Chuit River basin…"

It is not clear, however, how the seasonal revision of the manganese irrigation criterion would be reflected in the actual revised water quality standards regulation. The draft revised designated use table shows the seasonal use revision (Table 3 of the use decision document, page 12), but does not indicate that the effect on criteria is limited to the manganese criterion for irrigation. This should be addressed to ensure that the scope of the seasonal criteria revision is clear.

2) Also with regard to the draft revised designated use table shown in Table 3 of the use decision document: To be consistent with the description of the intended seasonal use revision, note "****" should be revised to refer to <u>agriculture</u> rather than "irrigation." This comment is also relevant to the copy of the draft revised designated use table that was included as an attachment to Brock Tabor's July 30, 2014 email, separate from the draft use decision document. We also note that in the separate table/attachment, note "****" is erroneously associated with Class (a)(1)(A)(iii). i.e., aquaculture, rather than Class (a)(1)(A)(ii) – agriculture.

3) At section I.3.c., page 3 of the draft use decision document, EPA suggests that ADEC include a reference to 40 CFR 131.10(a) as follows:

> <u>"Consistent with 40 CFR 131.10(a), ADEC has considered the use and value of the Bass, Middle, and Lone Creek drainages and concludes that</u> Subsistence and commercial related agriculture, including irrigation, is not attainable during cold weather months (September 16 to May 31) in these drainages in the foreseeable future due to climatic conditions, lack of access to markets, and lack of infrastructure."

4) At section III.b of the draft use decision document, "Evidence Supporting the Department Decision," ADEC should ensure that citations to any supporting documentation are provided, such as to support the statements on page 10 that agriculture "has never been demonstrated (or documented) within the watershed" and that homesteading operations have not occurred on or after November 28, 1975.

5) ADEC should ensure that the evaluation considers livestock watering in addition to irrigation.

6) ADEC should include documentation of how the June 1 to September 15 growing season was established.

7) ADEC should include a discussion in the use and value assessment as to whether there are any downstream uses that could potentially be affected by reclassification of the agricultural use to a seasonal agricultural use. For example, are there any year-round agricultural uses of the Chuit River that may not be adequately protected by the lack of the manganese irrigation criteria upstream from mid-September to late May?

8) EPA will be interested in any comments that Alaska receives from potentially impacted entities, such as tribal communities. EPA recommends that ADEC specifically reach out to stakeholders, such as Tyonek Native Village, and request their input regarding agricultural uses of the Chuit River and its tributaries.

D. Downstream Protection

EPA commends ADEC for completing a loading study to evaluate the protectiveness of the SSC for aluminum, copper, and zinc to downstream waters. ADEC notes in the draft decision document that a study of downstream protection also is in progress for the manganese SSC. EPA is continuing to review ADEC's loading study for aluminum, copper, and zinc and, in light of our SSC comments noted above, is focusing its review on the analytical methods underlying the study findings. EPA plans to provide comments on the study to ADEC by early January (mid-December is a possibility).